Extended Littoral Battlespace (ELB) Secure Network Voice Gateway

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***Abstract*¾ The Extended Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) uses wireless Local Area Network (LAN) technology to provide U.S. Marines in the field with multimedia connectivity to shore-based and afloat command and control centers. Computer network voice communication services are being evaluated and demonstrated as part of the ELB project. A gateway is needed for network voice users to communicate with users on other tactical voice and military telephone systems. We describe a scalable network voice gateway based on commercial off-the-shelf technology to be demonstrated as part of the ELB ACTD. Concepts for future capabilities and design issues are also discussed.**

BACKGROUND

Intelligent voice communication gateways are becoming an important component of integrated-services networks. In addition to establishing connectivity among disparate voice systems, modern signal processing and computer automation can be applied to provide a new range of capabilities. Services such as call monitoring, conference bridging, and automated "patching" can be practically attained. With the addition of signal processing, advanced capabilities such as speech-controlled services can be created. For example, users of legacy secure and tactical voice systems can access new capabilities using voice activated dialing through the gateway without modification of their terminal equipment. Also security features including authentication based on speaker-recognition are possible with an intelligent gateway in the system.

As part of its integrated demonstration system, ELB is using computer-based network voice technology for point-to-point and group-wise (via IP Multicast) communications. The Interactive Voice eXchange (Ivox) tactical network voice application provides these capabilities [1]. This paper describes our approach for developing a network voice gateway for the ELB ACTD.

APPROACH

As part of our ongoing work at the Naval Research Laboratory (NRL) in support of next generation secure voice systems we have produced a gateway built from commercially-available computer telephony components. Our gateway is capable of providing a scalable, cost-effective solution for integrating existing Navy and DoD tactical voice systems with commercial telephony technologies including Plain Old Telephone service (POTS) and Integrated Services Digital Network (ISDN). The commercially available components used for this platform are built to an industry standard (SC-Bus) for computer-telephony applications. With the gateway, ELB wireless LAN users will be able to talk with users on commercial telephony and tactical voice systems. The long-term viability of the gateway approach is ensured through the use of commercial standards, architecture, and components. Our goals for the voice gateway also include investigating advanced services.

We are using a two-phased approach to provide voice gateway capabilities for the ELB milestone demonstrations. The Phase I gateway capability will consist of a PC-host platform interfaced to a single Plain Old Telephone Service (POTS) line. This PC gateway platform will run a modified version of the Ivox application extended with simple network-to-telephone system call forwarding capabilities. This allows early demonstration of network voice technology and provides an opportunity to define and test the gateway features of the Ivox network voice protocol.

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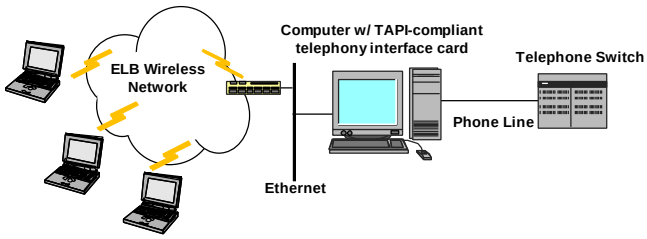

Fig. 1. – Phase I ELB Voice Gateway Architecture

The Phase II gateway will be based on scalable commercially-available components. This will allow a single gateway platform to handle many simultaneous calls, interface to different types of legacy voice systems, and provide the potential for demonstration of some of the advanced "intelligent" services described above. The legacy voice services may include Plain Old Telephone Service (POTS), the Defense Red Switched Network (DSRN), and secure tactical voice terminals(e.g. SINCGARS) like those accessed with the U.S. Navy's Single Audio System (SAS).

SCALABLE GATEWAY ARCHITECTURE

The second phase of this effort will be to develop a scalable, multiple port telephony gateway which will be capable of routing calls to/from network voice systems (e.g. Ivox, H.323), voice systems based on PSTN technology (ISDN, POTS), and tactical voice communication systems. The gateway capabilities developed for Ivox will be ported into this system and the software will be capable of connecting to the gateway's interfaces. Additionally, other network-based voice systems, such as those based on emerging International Telecommunication Union (ITU) H.323 and/or Internet Engineering Task Force (IETF) IP Telephony standards, can be supported by this platform as appropriate SC-Bus interfaces, processor cards, and software become available. It should also be noted that it is planned in the future for the Ivox application to support interoperability with these standards-based systems in addition to its current low data rate and IP Multicast capabilities. Fig. 2 provides an overview of the architecture of the proposed Phase II gateway platform.

The architecture depicted in Fig. 2 shows the interface capabilities that can be provided. Multiple combinations of interface and processing cards could be utilized in different configurations to meet specific requirements for voice system interconnectivity and capacity at different sites. Also, as new SC-Bus gateway cards become available, new features can be readily introduced into the gateway. For example, ITU H.323 Gatekeeper or conference bridging functionality could be added with appropriate interface cards and host system software. The initial goals for the ELB demonstration are to provide the Ivox gateway capability in a more scalable fashion than the Phase I approach, to extend the gateway's support of interfaces to other legacy tactical voice nets, and to explore the potential value of advanced features including

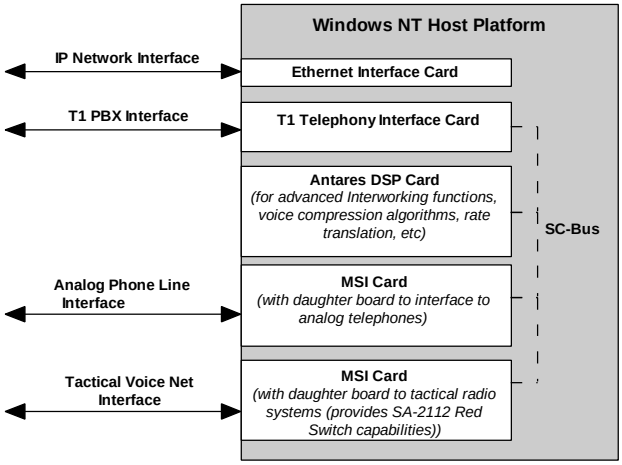

Fig. 2. – Phase II ELB Voice Gateway Platform

voice activated dialing and speaker recognition. The specific capabilities of the gateway platform will be developed in cooperation with ongoing research and development efforts sponsored by SPAWAR Systems Command in next generation Navy and DoD secure voice systems.

LONG-TERM GOALS AND ISSUES

Network-centric voice technology can yield multiple benefits for tactical and strategic voice systems [2]. Beyond the scope of the ELB demonstration, we see a number of issues that will influence the widespread adoption of network secure voice and the role gateways will play in providing interoperability with other systems. These issues include the scope and direction of commercial and open systems standards, the value of new services to users, and the ability of an overarching architecture to address security, performance, and Network concerns [3].

COMMERCIAL AND OPEN SYSTEMS

Commercial and open system standards are an important element in developing an architecture that remains viable and economical. When you view secure voice communications as another network application with data to transfer from source to destination (albeit with real-time transfer requirements), it follows that well-defined *application-layer* standards are needed to provide encapsulation of voice data content for transport across possibly different network types and physical communication links. This approach can provide independence of secure voice content from underlying communications technology making it possible to provide true end-to-end security even when gateways between different types of communication systems are required.

The most widely-recognized set of standards related to network voice is based around the ITU H.323 standard [4] including the H.245 standard for call setup and signaling and

the emerging H.235 standard which describes security mechanisms. These standards also provide for optional video communication and provide for synchronization to other data communication services (e.g. electronic "whiteboarding") in addition to voice and audio. The Internet Engineering Task Force (IETF) has also formed an Internet Telephony Working Group which is working in conjunction with the ITU to define standards explicitly related to the Internet. An important aspect of the ELB gateway development will be to evaluate the applicability of these standards and technology with respect to the requirements of tactical and secure voice communication.

There are some military and secure voice requirements which may not be met within the current scope of these standards. For example, interfaces to push-to-talk controlled or half-duplex systems may not be provided and mechanisms for key management and exchange may not be currently sufficient for DoD secure voice needs. We plan to provide specific recommendations to these standards working groups as a product of our gateway effort. Active participation in developing these standards may lead to commercial products that either meet military requirements or are easily adapted to meet them. And as these standards mature, voice systems centered around them will be capable of providing new services and features.

GATEWAY SERVICES

A gateway platform can provide services beyond simple interconnection of different voice communication systems. For example, data rate translation can be used to provide voice communications among users on networks or communication links with very different capabilities. A gateway can be used to interface "system-high" unencrypted secure systems with systems using end-to-end encryption. A gateway can also tie users of point-to-point voice communication systems (e.g. POTS) into netted voice systems (e.g. tactical radio voice nets or multicast network voice groups).

Other voice communication services, although possibly viewed as peripheral to the function of a *gateway* platform, might prove to be logical features of the gateway system, particularly if the co-location of these services can simplify system management. These features include automated directory services, conference session management functions, and management of network bandwidth utilization policy .

NETWORK ARCHITECTURE

Since secure voice communication is often considered a mission-critical service, it is important that any associated network architecture, whether providing actual transport of voice data or just playing a role in call setup, provide sufficient performance and robustness. Mechanisms for ensuring appropriate quality-of-service (QoS) and enforcing usage policies in accordance with military needs are important. For example, voice call prioritization and call "bumping" procedures need to be supported when the total user demand exceeds the available system capacity.

SECURITY

Given the key role gateways play tying systems together, security is a very important consideration in platform design. This applies to gateway platforms interconnecting secure voice communication systems as well as other gateway functions including directory services, bandwidth management services, or voice system interconnectivity services. It is critical that network architects and developers consider the needs of voice communications in the design of future data communication systems and networks.

SUMMARY

The ELB project is investigating, evaluating, and demonstrating advanced network technologies in the context of tactical communications. Voice communication is a critical aspect of the complete system architecture. The approach described here provides for the development of a significant enhancement to voice communication connectivity as part of the ELB demonstration. This approach also offers long term transition potential into future Navy and DoD communication systems. Because of the ability to leverage ongoing work at NRL, the gateway capability described can be achieved in a time frame compatible with ELB milestone demonstrations and at practical cost.

Exploring the role of network voice technology with respect to tactical user needs can have an impact on the development of emerging standards and products in this technology area with the approach outlined here. Also, this project provides an opportunity to investigate and capture military user requirements for secure voice functionality and interconnectivity among different users and systems. Additionally, a number of long-term issues and considerations must be addressed to arrive at a final system architecture. This project will help develop an awareness and a better understanding in the military community of the potential benefits and ongoing issues associated with this technology area.

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